

CLAIMS

1. An ultrasonic diagnostic apparatus, comprising:
 - transmission means for transmitting at least one ultrasonic signal
 - 5 from a surface of a skin of a subject toward a blood vessel of the subject;
 - reception means for receiving an ultrasonic echo reflected by the blood vessel and converting the ultrasonic echo into an electric signal to obtain the ultrasonic echo signal in a depth direction from the surface of the skin;
 - 10 movement detection means for analyzing a phase of the ultrasonic echo signal in a direction traversing the blood vessel to calculate a movement amount in each of a plurality of regions including a blood vessel wall composing the blood vessel and a vicinity of the blood vessel wall;
 - analysis means for analyzing a state of the blood vessel based on a
 - 15 variation in the calculated movement amount in each of the regions;
 - boundary position detection means for detecting a boundary position between a blood flow region and the blood vessel wall of the blood vessel based on a result of the analysis by the analysis means; and
 - stability judgment means for comparing the boundary position
 - 20 detected by the boundary position detection means with a detection result in a previous cycle.
2. The ultrasonic diagnostic apparatus according to claim 1, further comprising an ROI (Region of Interest) positioning means for positioning an
- 25 ROI where the boundary position in the depth direction from the surface of the skin is to be detected by the boundary position detection means,
 - wherein the ROI positioning means positions the ROI so that the ROI lies astride at least one of an anterior wall of the blood vessel wall on a side closer to the transmission means and a posterior wall of the blood vessel wall
 - 30 on a side farther from the transmission means.

3. The ultrasonic diagnostic apparatus according to claim 1, wherein the transmission means transmits a plurality of ultrasonic signals toward a plurality of regions in a longitudinal direction of the blood vessel, the boundary position detection means detects the plurality of boundary positions
5 in the longitudinal direction of the blood vessel, and the stability judgment means compares the plurality of boundary positions detected by the boundary position detection means, thereby judging stability of a result of the detection of the boundary positions.
- 10 4. The ultrasonic diagnostic apparatus according to claim 1 or 2, wherein the boundary position detection means detects the plurality of boundary positions in the depth direction from the surface of the skin,
the apparatus further comprising a blood vessel diameter calculation means for calculating a diameter of the blood vessel based on the plurality of
15 detected boundary positions.
5. The ultrasonic diagnostic apparatus according to claim 4, wherein the stability judgment means compares the diameter of the blood vessel calculated by the blood vessel diameter calculation means with a calculation
20 result in a previous cycle, thereby judging stability of a result of the detection of the boundary positions.
6. The ultrasonic diagnostic apparatus according to any one of claims 1 to 5, wherein the boundary position detection means detects the boundary
25 positions in the plurality of regions in the longitudinal direction of the blood vessel,
the apparatus further comprising a pulse wave propagation speed calculation means for calculating a pulse wave propagation speed indicating a speed at which a pulse wave propagates, based on a variation with time in
30 the plurality of boundary positions detected by the boundary position

detection means.

7. The ultrasonic diagnostic apparatus according to claim 6, wherein the stability judgment means compares the pulse wave propagation speed
5 calculated by the pulse wave propagation speed calculation means with the pulse wave propagation speed calculated in a previous cycle, thereby judging stability of a result of the calculation of the pulse wave propagation speed.

8. The ultrasonic diagnostic apparatus according to claim 6 or 7, wherein
10 the pulse wave propagation speed calculation means calculates pulse wave propagation speeds in a plurality of adjacent regions in the longitudinal direction of the blood vessel, and the stability judgment means compares the pulse wave propagation speeds in the plurality of adjacent regions, thereby judging stability of a result of the calculation of the pulse wave propagation
15 speeds.

9. The ultrasonic diagnostic apparatus according to any one of claims 1 to 8, wherein the boundary position detection means detects a boundary position between a tunica intima and the blood flow region of the blood vessel and a
20 position of a tunica media of the blood vessel based on a hardness value of tissue in the depth direction, and the stability judgment means compares the boundary position and the position of the tunica media detected by the boundary position detection means with the boundary position and the position of the tunica media calculated a predetermined number or more of
25 cycles prior to the present cycle, thereby judging stability of a result of the detection of the boundary position and the position of the tunica media.

10. The ultrasonic diagnostic apparatus according to any one of claims 1 to 9, wherein the transmission means transmits a plurality of ultrasonic signals
30 toward a plurality of regions in the longitudinal direction of the blood vessel,

the boundary position detection means detects the boundary positions between the tunica intima and the blood flow region of the blood vessel and the positions of the tunica media of the blood vessel in a plurality of regions adjacent to each other in the longitudinal direction of the blood vessel, and
 5 the stability judgment means compares the boundary positions and the positions of the tunica media adjacent to each other that are detected by the boundary position detection means, thereby judging stability of the detection of the boundary positions and the positions of the tunica media by the boundary position detection means.

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11. The ultrasonic diagnostic apparatus according to any one of claims 1 to 10, further comprising an IMT (Intima-Media Thickness) calculation means for measuring an IMT, which is a thickness from the tunica intima to the tunica media, based on a variation with time in the boundary position
 15 between the tunica intima and the blood flow region of the blood vessel and a variation with time in the position of the tunica media of the blood vessel, wherein the stability judgment means judges stability of a result of the detection of the boundary position by the boundary position detection means based on the IMT measured by the calculation means.

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12. The ultrasonic diagnostic apparatus according to claim 11, wherein the IMT calculation means calculates the IMT values in a plurality of regions adjacent to each other in the longitudinal direction of the blood vessel, and the stability judgment means compares the IMT values in the plurality of
 25 regions, thereby judging stability of a result of the detection of the boundary position by the boundary position detection means.

13. The ultrasonic diagnostic apparatus according to any one of claims 1 to 12, further comprising display means for displaying the stability judged by
 30 the stability judgment means.